

## Interpreting equilibrium expressions using the value of K

1) The table below shows the value of the equilibrium constant,  $K_c$  at two different temperatures.

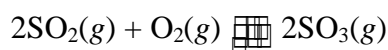
Temperature/ $^{\circ}\text{C}$	Value of $K_c$
200	$8.00 \times 10^{-3}$
350	0.612

(i) Circle the species that will be in the highest concentration at  $200^{\circ}\text{C}$ .  $\text{PCl}_5(\text{g})$  or  $\text{PCl}_3(\text{g})$

(ii) Explain your answer.

(iii) Calculate the concentration of  $\text{PCl}_5$  at equilibrium at  $350^{\circ}\text{C}$ , if the concentrations of  $\text{PCl}_3$  and  $\text{Cl}_2$  are both  $0.352 \text{ mol L}^{-1}$ .

2) The reaction between sulfur dioxide gas and oxygen gas at a particular temperature to make sulfur trioxide gas can be represented as:



For this equilibrium at this temperature, the value of  $K_c$  is 280.

The following three gases are mixed in a 1L container.

$$[\text{SO}_2] = 0.500 \text{ mol}$$

$$[\text{O}_2] = 0.100 \text{ mol}$$

$$[\text{SO}_3] = 0.700 \text{ mol}$$

Justify whether the reaction would proceed in the forward OR reverse direction when the gases are mixed

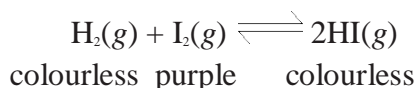
3) The following reaction can be used to produce gaseous methanol,  $\text{CH}_3\text{OH}$ , from carbon monoxide and hydrogen.



At  $25^{\circ}\text{C}$ , the equilibrium constant,  $K_c = 2.20 \times 10^{-4}$ .

Explain what this indicates about the relative amounts of reactants and product at equilibrium.

**4)** Hydrogen gas and iodine vapour are placed in a sealed container at 445°C. These gases combine to form hydrogen iodide gas. This equilibrium can be represented by:



(a) Describe how an observer would know that the system had reached equilibrium.

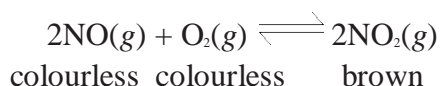
(b) At 445°C, the equilibrium constant  $K_c = 49.5$ . Name the species that will be in the highest concentration at this temperature. You may name one, or more than one species in your answer. Explain your answer.

(c) When the temperature of the equilibrium system is raised from 445°C to 1000°C (at constant pressure), the value of  $K_c$  decreases.

Temperature / °C	Value of $K_c$
445	49.5
1 000	13

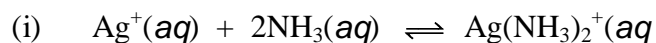
Use this information to determine whether the reaction between hydrogen and iodine is exothermic or endothermic. Justify your reasoning.

**5)** Nitrogen monoxide gas reacts with oxygen gas to form nitrogen dioxide gas. The equilibrium reaction can be represented by:



At 230°C the equilibrium constant for this reaction has a value of  $6.44 \times 10^5$ . State which gas will be in the highest concentration at 230°C. Explain your answer in terms of  $K_c$  and the colour seen.

6)



=

- (ii) At 25°C the value of  $K_c$  is  $1.70 \times 10^7$ . **Circle** the species that would be present in the higher concentration in the equilibrium mixture at this temperature. Justify your choice.



- 7) (i) At 200°C the value of  $K_c$  is  $1.10 \times 10^{-5}$ . **Circle** the species that would be present in the higher concentration in the equilibrium mixture at this temperature. Justify your choice.

